

**Example of application of emissions results to fleet
for heavy-duty highway diesel engines**

| Engine Group | Engines required | Estimate of contribution to fleet |
|-------------------|------------------|-----------------------------------|
| Light-heavy duty | 1 | 15% |
| Medium-heavy duty | 2 | 20% |
| Heavy-heavy duty | 2 | 35% |
| EGR-equipped | 2 | 30% |

| Engine Group | Engines tested | % change w.r.t. base fuel (parentheses not significant) | | | |
|-------------------------|----------------|--|-------|-------|------|
| | | NO _x | PM | HC | CO |
| Light-heavy duty | 0 | 0 | 0 | +5 | 0 |
| Medium-heavy duty | 2 | -6 | (-2) | (+11) | (+2) |
| Heavy-heavy duty | 2 | -4 | -6 | +5 | (-3) |
| EGR-equipped | 0 | 0 | 0 | +5 | 0 |
| Fleet-wide verification | | - 2.6 | - 2.1 | +6.2 | +0.4 |

$$\begin{aligned}
 \text{Fleet NO}_x = & 15\% \times 0 \\
 & + 20\% \times -6 \\
 & + 35\% \times -4 \\
 & + 30\% \times 0 \qquad = - 2.6
 \end{aligned}$$

$$\begin{aligned}
 \text{Fleet PM} = & 15\% \times 0 \\
 & + 20\% \times 0 \\
 & + 35\% \times -6 \\
 & + 30\% \times 0 \qquad = - 2.1
 \end{aligned}$$

$$\begin{aligned}
 \text{Fleet HC} = & 15\% \times 5 \\
 & + 20\% \times 11 \\
 & + 35\% \times 5 \\
 & + 30\% \times 5 \qquad = + 6.2
 \end{aligned}$$

$$\begin{aligned}
 \text{Fleet CO} = & 15\% \times 0 \\
 & + 20\% \times 2 \\
 & + 35\% \times 0 \\
 & + 30\% \times 0 \qquad = + 0.4
 \end{aligned}$$

Adjustment for alternative base fuel

-6.2% = Change in NO_x for California diesel with respect to nationwide average fuel

X = Change in NO_x for candidate fuel with respect to nationwide average fuel

% change in NO_x for candidate fuel with respect to California diesel = $(X + 6.2) / (1 - 6.2/100)$

Table III.F-2 of EPA Staff Discussion Document

| | |
|-----------------|----------|
| NO _x | - 6.2 % |
| PM | - 8.5 % |
| HC | - 19.4 % |

Calculation of emission impacts for cumulative effects

$$\begin{aligned}\ln(\text{NO}_x) = & \quad a1 \times \text{VEH1} \\ & + a2 \times \text{VEH2} \\ & + \text{etc.} \\ & + b1 \times \text{VEH1} \times \text{mileage} \\ & + b2 \times \text{VEH2} \times \text{mileage} \\ & + \text{etc.} \\ & + c \times \text{CANDIDATE}\end{aligned}$$

If coefficient c is statistically significant, then

$$\begin{array}{l} \text{\% change in fleet-wide} \\ \text{NO}_x \text{ emissions} \end{array} = [\exp(c) - 1] \times 100\%$$